DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 03/01/2011 has been entered.

Response to Amendment

2. Applicant's amendment of 03/01/2011 does not place the Application in condition for allowance.

3. Claims 1-23 and 43-46 are currently pending. Applicant has amended claim 8, cancelled claims 24-42, and added new claim 46. Claims 6, 8, 13 and 19 are withdrawn from consideration as being part of non-elected invention.

Status of the Objections or Rejections

4. The rejection of claims 1-5, 7, 9-12, 14-18, 20-23 and 43-45 from the Office Action dated 09/01/2010 are maintained. New ground of rejection is presented for newly added claim 46.

Claim Rejections - 35 USC § 102

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Claims 1-5, 7, 9-10, 17, 21-22 and 43-46 are rejected under 35 U.S.C. 102(b) as being anticipated by Smalley et al. (WO 98/39250) with evidence is provided by Garg et al., ("Effect of chemical functionalization on the mechanical properties of carbon nanotubes," Chem. Phys. Lett., October 16, 1998, 295, 273-278).

Regarding claims 1, 4-5, 9-10, 22 and 43-46, Smalley teaches an organic photovoltaic conversion device such as a solar cell (page 50, lines 14-30) comprising a polymer matrix material having carbon nanotubes well dispersed therein (page 6, lines 3-5; page 30, line 18-page 33, line 20; page 35, line 1-page 37, line 27; page 62, line 3 – page 63, line 3; claims 117-122) and organic dye molecules (page 50, lines 14-30) are attached to defect sites on the carbon nanotubes (the ends of the nanotubes are chemically functionalized/derivatized and therefore forms defect sites at the ends (page 30, line 18-page 33, line 20; page 35, line 1-page 37, line 27), and the dyes are bonded to the ends, i.e., defect sites (page 50, lines 22-24)) (see Garg, page 227, right column, which discloses the functionalization forms defects on the walls of CNTs). The reference further teaches that the polymer matrix material is selected from polyamides, polycarbonates etc. (page 62, lines 23 – page 63, line 3). Smalley further teaches that the defect sites are located along the carbon nanotube bodies (at the end of the carbon nanotube bodies).

With respect to claim 46, it is further noted that he determination of patentability is based on the product, and not on the method (forming defect sites by acid or anionic treatment) of making the product. “Even though product-by-process claims are limited by and defined by the

process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process" (MPEP §2113) (In re Thorpe, 777F.2d 695, 698, 227 USPQ 964,966 (Fed. Cir. 1985)).

Regarding claim 2, Smalley further discloses the photovoltaic organic molecules are adapted to generate a photocurrent upon absorbing radiation (page 50, lines 22-24). Moreover, it has been held that the recitation that an element is "adapted to" perform a function is not a positive limitation but only requires the ability to perform so (see MPEP §2144).

Regarding claim 3, Smalley further discloses that the photovoltaic organic molecules are bonded to the defect sites on the carbon nanotubes such that the absorbed radiation provides excitation transfer from the photovoltaic organic molecules to the carbon nanotubes (page 30, line 18-page 33, line 20; page 35, line 1-page 37, line 27; page 50, lines 14-30). With respect to the process step "chemisorbed", the patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process" (MPEP §2113; In re Thorpe, 777F.2d 695, 698, 227 USPQ 964,966 (Fed. Cir. 1985)).

Regarding claim 7, Smalley further discloses that the defect sites on the carbon nanotubes comprise a carboxyl group or a C1-6 alkyl group (page 32, lines 10-14).

Regarding claims 17-18, Smalley further discloses that the device comprises two electrodes (#11 and #15 as shown in fig. 1 of U.S. Patent 5,084,365 to Gratzel et al., which is

incorporated in Smalley in its entirety at page 50, lines 15-16) of which at least one is transparent to radiation (4:19-22 of Gratzel).

Regarding claim 21, Smalley further discloses that the matrix material comprises a flexible thin film (polymer such as polyamide which is flexible) (page 62, lines 23 – page 63, line 3) on a substrate (substrate of Gratzel, 4:19-24), and the overall stiffness of the device is determined by the stiffness of the substrate (see 4:19-24 of Gratzel which discloses the substrate can be made of glass or plastic, and therefore the stiffness, i.e. rigidity/flexibility, of the device depends on the material used for the substrate).

Claim Rejections - 35 USC § 103

7. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

8. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley as applied to claim 1 above, and further in view of Gopidas et al. ("Photophysics and photochemistry of phenosafranin dye in aqueous and acetonitrile solutions," Photochem. Photobiol, A: Chem., 1989, 48, 291-301).

Regarding claims 11 and 12, Applicant is directed above for complete discussion of Smalley with respect to claim 4 above, which is incorporated herein. The reference further discloses that the dye comprises a photoactive dye such as cis-(bisthiacyanato bis (4,4'-dicarboxy-2-2'-bipyridine Ru (II) (page 50, lines 22-24). However, the reference is silent as to whether the photoactive dye comprises phenosafranin (PSF).

Gopidas teaches that phenosafranin (PSF) absorbs strongly in the visible region and such dyes have important application in extending the absorptive range of large bandgap semiconductors and improving the performance of the cell (see Introduction, page 291).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized the PSF dye in the solar cell of Smalley to enhance the absorption of lights in the visible region, as taught by Gopidas, and as also the selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in Sinclair & Carroll Co. v. Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945) (MPEP § 2144.07).

9. Claims 14-16 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley as applied to claims 1 and 5 above, and further in view of Shiratsuchi et al. (US 6,084,176).

Regarding claims 14-15, Applicant is directed above for complete discussion of Smalley with respect to claim 5 above, which is incorporated herein. Smalley further discloses a charge transporting layer (electrolyte layer of Gratzel) is located in contact with the matrix material. However, the reference is silent as to whether the charge transporting layer is at least one of a p and n type charge transporting layers.

Shiratsuchi discloses a solar cell (fig. 1) wherein the charge transporting layer (5) comprises p-type compound such as hydrazone compound (col. 14, lines 7-23) to transfer holes generated in the photoactive layer.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized the charge transporting layer of Shiratsuchi in the device of Smalley to transfer holes generated in the photoactive layer, as taught by Shiratsuchi.

Regarding claims 16 and 18, Applicant is directed above for complete discussion of Smalley with respect to claim 1 above, which is incorporated herein. However, the reference is silent as to different types of photovoltaic organic molecules attached to the carbon nanotubes, wherein the different types of molecules have a peak sensitivity to different radiation wavelengths.

Shiratsuchi discloses a mixture of dye allows the wavelength range of solar cell as broad as possible (12:58-62).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized a mixture of dye in the device of Smalley in order to make the wavelength range of solar cell as broad as possible as taught by Shiratsuchi.

10. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley as applied to claim 1 above, and further in view of Bulovic et al. (US 6,352,777).

Applicant is directed above for complete discussion of Smalley with respect to claim 5 above, which is incorporated herein. The reference is silent as to whether the solar cell comprises a bilayer cell containing a heterojunction of two charge generating layers each containing a different type of organic photovoltaic molecule.

Bulovic discloses a solar cell (see embodiment of figure 8, 4:36-54 and 18:28-57) comprising a plurality of stacked photosensitive subcells, each subcell comprising a bilayer cell

containing a heterojunction of two charge generating layers each containing a different type of organic photovoltaic molecule (one layer comprises hole transport layer, and other comprises electron transport layer, and forms heterojunction as the interface).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized the bilayer cell of Bulovic in the device of Smalley to allow for device with plurality of stacked photosensitive subcells such that more lights can be harvested.

11. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley as applied to claim 1 above, and further in view of Homma (US 4,611,914).

Applicant is directed above for complete discussion of Smalley with respect to claim 4 above, which is incorporated herein. The reference is silent as to whether the device is formed on an outer surface of a space suit or a space ship.

Homma discloses a space suit or space ship (satellite) and further discloses that solar cells are formed over the outer surface of the satellite body to supply sufficient electric power generated by the solar cell (see figures, 1:13-20).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized the device of Smalley over the space suit/ship to supply sufficient electric power generated by the solar cell, as taught by Homma. Since the device is formed on the outer surface of the space suit/ship, the matrix material must also be formed on the outer surface of the space suit/ship as the matrix material is part of the solar cell.

Double Patenting

12. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., In re Berg, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); In re Goodman, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); In re Longi, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); In re Van Ornum, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); In re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and In re Thorington, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

13. Claims 1-5, 7, 9-12, 14-19, 21-23 and 43-46 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-38 of copending Application No. 10/537,942. Although the conflicting claims are not identical, they are not patentably distinct from each other because claims of the copending application encompass the limitations of the instant claims.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

14. Applicant's arguments filed on 03/01/2011 have been considered but they are not persuasive.

On pages 6 and 7 of Remarks, Applicant argues Smalley fails to disclose photovoltaic organic molecules attached to the defect sites on or along the carbon nanotube bodies.

The examiner respectfully disagrees. Smalley teaches an organic photovoltaic conversion device such as a solar cell (page 50, lines 14-30) comprising a polymer matrix material having carbon nanotubes well dispersed therein (page 6, lines 3-5; page 30, line 18-page 33, line 20; page 35, line 1-page 37, line 27; page 62, line 3 – page 63, line 3; claims 117-122) and organic dye molecules (page 50, lines 14-30) are attached to defect sites on the carbon nanotubes (the ends of the nanotubes are chemically functionalized/derivatized and therefore forms defect sites at the ends (page 30, line 18-page 33, line 20; page 35, line 1-page 37, line 27), and the dyes are bonded to the ends, i.e., defect sites (page 50, lines 22-24)) (see Garg, page 227, right column, which discloses the functionalization forms defects on the walls of CNTs). The reference further teaches that the polymer matrix material is selected from polyamides, polycarbonates etc. (page 62, lines 23 – page 63, line 3). Smalley further teaches that the defect sites are located along the carbon nanotube bodies (at the end of the carbon nanotube bodies).

On page 7 of Remarks, Applicant further argues that Smalley uses single-wall carbon nanotubes precisely because they are substantially defect free. See e.g., page 8, lines 20-27.

The examiner respectfully disagrees. Smalley on page 31 only discloses that only the cylindrical grapheme sheet by itself is defect-free (page 31, line 10), but not the overall structure as shown by formulae I, II and III (page 31, line 5). Smalley further teaches that the cylindrical

grapheme sheet is functionalized by adding fullerene cap and/or R_n, R_n^1, R_n^2, R_n^3, R_n^4 and R_n^5. Hence, defect sites are formed at the ends as evidenced by Garg that the functionalization forms defects on the walls of CNTs.

Correspondence/Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GOLAM MOWLA whose telephone number is (571) 270-5268. The examiner can normally be reached on M-Th, 0800-1830 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ALEXA NECKEL can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/G. M./
Examiner, Art Unit 1723

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